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been noted repeatedly, nor that there should be general agreement as to its main cause. I should also like to add the explanation that I did not aim to present novel so much as significant truth, and that in writing I bore in mind the maxim of Dr. Johnson to the effect that men need to be reminded rather than informed.

It would also be idle to discuss the orthodoxy of my method. "Orthodoxy," a witty English bishop once explained, "is my doxy; heterodoxy is another man's doxy," and the same definition will serve for what is sound scientific method to-day. I did not aim at orthodoxy of method, but at effective presentation of truth in writing; and it seems to me that this is more important than orthodox procedure. In my discussion I had to treat a very large subject within very narrow limits, and there is less detail in it than I should wish, but the practical result of my method was to enumerate certain abuses and limitations that I thought I detected in our educational theories and practises, and to explain them as the result of certain economic and temporal conditions the existence of which I indicated. Now whatever the theoretical excellence and unquestioned orthodoxy of Professor Woodworth's method, its practical result in his criticism, if he wished to counteract the effect of what I said, should have been to bring forward some reason for believing that the abuses and limitations that I have pointed out do not exist, and that I am either mistaken or malicious when I say that they do. Instead of this, however, its practical result is to use a great many indefinite expressions as if they had an exact significance, and to claim that my case fails unless college presidents and members of governing boards profit directly from the way they administer their trust.

The question of the consistent and accurate use of language is, I know, quite as indeterminate as the two preceding points I have dealt with; for experience has taught me how the mobile and fluid nature of philosophic ideas prevents their being designated and differentiated with entire success by

means of language. In an article as compressed as mine, I had to use far fewer checks and elaborations than the character of the ideas demanded, but in spite of this, I do not feel that Professor Woodworth has demonstrated that I have been guilty of any loose or inconsistent use of language. I used the word commerce, I think, consistently as "a gigantic business," founded as much on the caprices as on the necessities of men, an activity which is therefore likely to become dominated by "a pursuit of gain" that is more apparent than real which, instead of being an aid to progress, becomes a corrupting influence by creating an indifference to or an unconsciousness of much good that is equally important but less tangible. I did not mean to deny the value of commerce, and I did mean to make clear my opinion that, as a guide for human activity, it is an improvement over anything that has directed society in its earlier stages. My purpose was simply to show that the absolute control of thought and aspiration by any one activity is bound to create weaknesses that it is the business of education to strive to correct. In using the word commerce in the sense I have given, I have used it in accordance with a definition at once more specific and more comprehensive than Professor Woodworth's definitive one; and I have also, I think, laid more emphasis on its vital principle than on its visible exterior, which seems to me a sufficient explanation of what my meaning is when I say (as he predicted I would) that his criticism is an illustration of a very marked tendency to deal with facts and to neglect principles.

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#### SCIENTIFIC BOOKS

*The Conservation of Natural Resources in the United States.* By CHARLES RICHARD VAN HISE. 8×5½ in., pp. xiv+413, 16 plates. New York, The Macmillan Company. \$2.00 net.

As an expert in ores, an authority on geol-

ogy, a leader in education, and a broad student of public affairs, President Van Hise is perhaps better equipped than any one else to treat the natural resources of the country, both in detail and in their relation to the general welfare; and the excellence of his equipment is attested by the completeness and timeliness of his treatise. Conservation of late has become a cult, the influence whereof extends to every section of the country and pervades a large part of our population; yet there is a dearth of data within public reach, partly by reason of the unfortunately limited edition of that three-volume report of the National Conservation Commission containing the fullest inventory ever made of the resources of a nation—and Van Hise's compact book is designed to meet the current condition.

Beginning with a summary history of the conservation movement, the natural sources of national existence are treated in order as mineral resources, water, forests and land, with a general discussion of conservation and mankind. Of the mineral resources the fuels—coal, peat, petroleum and natural gas—are quite properly placed first. Next to America's contribution of a form of government, the most striking fact in the development of the United States is the exploitation of the mineral fuels. This has been done with extraordinary rapidity—virtually within three quarters of a century, chiefly within a generation. The use of mineral fuels not merely made America a manufacturing nation; it multiplied human power over lower nature, and intensified intelligence to a degree revolutionizing the thought of the world. At first idly deemed unlimited in the slack thinking of the time, the use of the abounding natural energy afforded by such fuels so stimulated both industrial and mental growth that new methods arose, especially that quantitative method which forms perhaps the highest expression of human advancement—and as the quantitative method naturally extended to the coals both their limits and the wastes of earlier exploitation were realized and finally measured. The United States contains 60 or

70 per cent. of the coal of the world, and is more richly endowed with petroleum and natural gas than any other country; yet the wastes were long greater than the uses, and even yet combustion is so imperfect that only a small fraction (probably less than 10 per cent.) of the thermal energy of the coal is actually utilized. But new standards are arising with the spread of the conservation movement; heedless waste is reprobated and is rapidly diminishing; while incomplete utilization is receiving attention, and engineers and inventors are devising means for more complete combustion of the coal and larger application of its energy to the development of power. Paradoxically enough, it would appear that the age of steam opened through the mineral fuels will be closed through better use of the same sources of energy; for coal gasified and used in gas engines averages twice the efficiency of the same coal burned under the steam boiler. America's coal underlies an area of some 500,000 square miles, or 13 per cent. of the country, and is estimated to amount to three trillion tons; of late it is mined at the rate of about 450,000,000 tons annually, or say 5 tons per capita for our people; at the current rate of use it would last several thousand years, while at the currently increasing rate (doubling once in seven or eight years) it would be exhausted within 150 years.

Next to coal it was iron that made this country industrially great; the high-grade ores have for a half-century been taken out of the ground and converted into finished product at a rate marking an epoch in world history. When the nation was founded a few pounds of iron sufficed for the average family; now the production exceeds 25,000,000 tons each year, or nearly 700 pounds for each man, woman and child of our entire population. Of high-grade ores we have less than 5,000,000 tons; at the currently increasing rate of mining it would not outlast the middle of the present century—though with proper economy and progressive recourse to low-grade ores the life of the supply will be prolonged at relatively increasing cost.

In no direction is the quantitative method of dealing with resources more novel and helpful than in connection with water—at once a mineral and the menstruum of vitality; and Van Hise applies the method effectively. The average rainfall of the United States is about 30 inches, or only half that required for full productivity of the soil; the aggregate volume is 215,000,000,000,000 cubic feet; or, expressed in terms already familiar throughout the semi-arid region, about 5,000,000,000 acre-feet annually—equivalent to ten Mississippi rivers flowing constantly. Of the total, about one third runs down to the sea in rivers of which many are navigable though little used in aid of commerce—for with the habitual extravagance of the world's wildest wasters our people prefer to pay three or four times the cost of water transportation for carriage of their abounding freight by rail. This is the run-off; and the remaining two thirds (forming the fly-off and the cut-off) are considered with respect to both uses and wastes. Not only are the leading facts well brought out, but the equities arising in connection with this resource are discussed with clearness and conviction. It is growing evident—indeed, it is already recognized by many influential citizens—that in the last analysis the waters of the country belong to the people of the country, and must be administered in their interest; and Van Hise cites and discusses the laws and decisions taking this trend.

Our once abounding but now sadly depleted forests are treated along the lines established by the work of the forest service, *i. e.*, at once as sources of timber, preservers of streams and enhancers of the beauty and habitability of the country as a home for a prosperous and patriotic people; and the extent, uses and wastes of the forest resources are listed and discussed in informing fashion. The lands are treated largely with reference to production—a production measured partly by the soil but yet more largely by the water applied to it naturally or through irrigation. Before the exploitation of the mineral resources and timber began, America was the home of a

freehold landed citizenry, and the abounding products of the soil not only easily sustained the food-producing population of the time, but left a large margin for export; but now that a large part of our people are engaged in manufacturing and ancillary industries rather than in producing staples for food and clothing, our exports of these staples are declining—and even at home the pinch of reduced production is felt in advancing prices. It is clearly a need of the time to augment the yield of staples, not merely per acre cultivated, but per worker in the field; it is not only needful to make two ears of grain grow where one grew before, but the farmer must double or triple the product of his own work in order that his manufacturing fellows may be fed; and this may be attained by judicious conservation of the energy residing in fertile soil and intelligent husbandry. For even the teeming population of to-day is not the end for this country; our inhabitants and industrial differentiation are increasing with each generation, and must continue to increase apace if this nation is to fulfill its manifest destiny as the chief home and strength of the Caucasian race. Consistently, Van Hise urges conservation and increase of the elements of fertility in the soil; he indicates and deplores the wastes due to soil erosion and negligent farming; and he applies his own expert knowledge in describing the phosphate deposits of the country and advocating their retention and use. In his closing division he especially emphasizes the current movement as one connected with the public welfare and brings out its patriotic character—for in very fact the perpetuity of this most exuberant and wasteful of nations is at stake.

Throughout, Van Hise crystallizes conservation as a definite and trenchant idea, a specific principle, a basis and guide for action: "Do the principles of conservation demand that it [legislation] shall be done?" (p. 97); "Conservation requires us to encourage concentration and coupling in order that we may get the greatest efficiency of the water" (p. 135); "Conservation does not demand that no tree be cut, but that whenever a

tree is cut, measures shall be enforced which will produce another tree" (p. 262)—these are typical expressions.

The book is an outgrowth of a series of twenty lectures, and the arrangement and style reflect the original presentation; there are occasional discontinuities and other minor imperfections which systematic construction in the study would have obviated. In view of that trenchant application of the quantitative method which the conservation movement expresses, it is unfortunate that the indefiniteness of thought and cloak for sharp practise involved in the "long ton" should find expression, still less the rhetorical monstrosity, "short ton"; as if there were in well-chosen American terminology any "short" ton—save that delivered by a dishonest dealer. A misleading expression is "reserves," applied to natural supplies—a term unhappily introduced in this country by a foreign student and carelessly adopted through mimetic instinct; there is indeed a "gold reserve," and there have been "forest reserves," but there are unfortunately no coal reserves or iron reserves in the United States—and the very use of the term tends to confuse thought and thereby retard desirable action.

On the whole, despite the few minor blemishes sure to disappear in later editions, Van Hise's book is a highly useful summary of the facts and statement of the principles involved in the conservation movement; and its issue would seem to meet an urgent need.

W J M.

*Theoretical Principles of the Methods of Analytical Chemistry Based upon Chemical Reactions.* By M. G. CHESNEAU. Authorized translation by AZARIAH THOMAS LINCOLN, Ph.D. and DAVID HOBART CARNAHAN, Ph.D. New York, the Macmillan Company. 1910. Pp. x + 184. \$1.75 net.

The book attempts to show that the phenomena and methods of analytical chemistry can be established on a theoretical basis of thermochemical data and thermodynamic principle, without the use of the electrolytic dissociation theory. In other words, it repre-

sents a systematic attempt at practical application of the views held by opponents of the dissociation theory, notably by Professor Kahlenberg.

It is divided into seven chapters. The first examines "the influence of the physical state of precipitates upon their purification by washing (size of grains, crystalline state, colloidal state)." The second chapter deals with the principal types of irreversible reactions used in analysis and with the theoretical principles involved. The third chapter deals with reversible reactions from the thermodynamic standpoint, carefully avoiding the use of the electrolytic dissociation theory: ionic concentrations are absent from the mass law equations, the molar concentrations being raised to empirical fractional powers (Van't Hoff's coefficient  $i$ ). The fourth chapter introduces the theory of solutions and includes a brief statement of the principal facts upon which the dissociation theory rests. The fifth chapter is devoted to an attempt to show that the dissociation theory can no longer be maintained in science and that it is decidedly overthrown by the work of Kahlenberg. The sixth chapter deals with analytical processes based upon double decomposition of salts. Here for the first time the principle of constancy of the solubility product is stated, then an attempt is made to show that it can be dispensed with, not only without loss, but with gain. In the last chapter we find, as a substitute for the Ostwald theory of indicators, one based upon "thermochemical data and the hydrolysis of salts in solution" and having "its origin in the principles set forth by Berthelot in his *Thermochimie*" (p. 167). We read here that the change of color of an acid indicator is due to the difference in color between the free acid and its alkaline salt.

On page 127 we read: "If the contradictions between the facts and the theory of ionization appear to require the rejection of the latter, one falls then into another difficulty, that of not explaining the necessity of introducing the coefficient  $i$  into the general law of equilibrium of Guldberg and Waage." The author thinks, however, that the molecular